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NATIONAL EUTROPHICATION RESEARCH PROGRAM ANNUAL NEWSLETTER

Federal Water Pollution Control Administration
Corvallis, Oregon

July 1970

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EUTROPHICATION RESEARCH NEWSLETTER

July 1970

FWQA, Ohio Basin Region
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US Department of the Interior
Federal Water Quality Administration
National Eutrophication Research Program
Pacific Northwest Water Laboratory
Corvallis, Oregon

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ANNUAL NEWSLETTER

JULY 1970

United State Department of the Interior
Federal Water Quality Administration, Northwest Region
Pacific Northwest Water Laboratory
National Eutrophication Research Program
200 S. W. Thirty-Fifth Street
Corvallis, Oregon 97330

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RESEARCH AND DEVELOPMENT IN EUTROPHICATION

Intramural

In 1969, under joint sponsorship of industry and government, development of a Provisional Algal Assay Procedure (PAAP) was proposed by a team of international experts. Since that time the procedure has been under intensive evaluation in order to insure that it is a reliable, reproducible procedure. NERP has served as the focal point for these evaluations and has used the procedure to determine the ability of many natural lake waters to support algal growth as well as the biostimulatory effect of various types of waste waters. At present it appears that the "bottle test" portion of the PAAP will become standardized within a relatively short time.

Both laboratory and in situ studies are being conducted to determine the effects of nitrilotriacetic acid (NTA) on algal growth and on the solubilization of minerals from lake sediments. These studies are being conducted for oligotrophic, mesotrophic and eutrophic lakes. This is part of a broad agency program to determine whether, from an ecological point of view, NTA is an acceptable substitute for phosphate builders in detergents.

Laboratory and field investigations are also being conducted to evaluate nutrient inactivation by chemical precipitation and adsorption as a method of lake restoration. Aeration, with and without induced mixing and destratification, is also being studied as a lake restoration mechanism.

An investigation is being carried out in cooperation with the U.S. Forest Service to study the incipient eutrophication of a pristine mountain lake. The results of this study are expected to aid in refinement of policies to maintain as nearly as possible the ultra-oligotrophic conditions of the lake under study as well as similar lakes elsewhere.

An evaluation is being made, both in the laboratory and in the field, to determine relative nutrient uptake by aquatic macrophytes from sediments and from water and to evaluate the feasibility of removing significant quantities of nutrients from lakes by weed harvesting.

A field station and pilot tertiary treatment plant at Shagawa Lake, Ely, Minnesota, has been the site of investigations to evaluate the effects of the removal of nutrients from the municipal waste

effluents on the recovery and restoration of a highly eutrophic lake. On the basis of the results of laboratory and *in situ* algal assays on the lake water, the waters of its tributaries, and waste effluents, it is anticipated that a full-scale phosphorus removal plant will be constructed at that location in the near future.

Research to elucidate the role of sediment-water interchange in the stimulation of algal growth is being conducted. Lake sediments, from both deep and shallow lakes from many parts of the country, are being studied. Lake Erie is included among them.

Studies have also shown that the occurrence of algal nutrients in atmospheric precipitation in some regions could constitute a significant source of nutrients for surface waters.

Extramural

The extramural grant and contract research program funded by NERP is designed to both complement and augment the intramural program. These research activities logically fall into five major categories; (1) understanding eutrophication, (2) ecological control of eutrophication, (3) biological control of eutrophication, (4) chemical control of eutrophication, and (5) mechanical control of eutrophication. A list of the current grants and contracts will be found in another section of this report. They include both fundamental and applied research studies and it will be noted that each of them will fall under one or more of these major categories.

With NERP serving as the focal point, research to evaluate the PAAP is also being conducted at three universities as well as industrial laboratories. While the investigations being conducted by industry are not funded by NERP, they are being coordinated through this laboratory.

Several studies are underway to determine the relative significance of inorganic and organic nutrients as well as light, temperature and other physical conditions upon the growth of algae. Limnological investigations of lakes of various trophic levels as well as studies of tidal and coastal waters are also being conducted. The potential significance of waste effluents and land management practices on eutrophication make up a significant part of the research activities.

Indian Creek Reservoir offers a unique opportunity to conduct biological, chemical and physical studies on an impoundment receiving only tertiary treated waste water. This reservoir was constructed to receive all the tertiary effluent from a new waste treatment plant of the South Tahoe Public Utility District. Indications are that it will become a valuable recreational asset to the area. Other studies are also underway on the effects of various phosphorus removal processes on algal growth.

Investigations are being conducted to study the exchange of nutrients between bottom sediments and the overlying waters as well as the nutrient transformations within the sediments. These studies are not only of value to our understanding of the eutrophication process, but also offer valuable information relating to dredging as a means of lake restoration.

In addition to dredging, several other methods are being investigated as potential methods of lake restoration. Included in these is a study of the effects of induced turnover via complete aeration of a aeration of the hypolimnion only in two Michigan lakes.

An investigation is underway to find microorganismns which are pathogenic to aquatic weeds. The microorganisms include bacteria, fungi and viruses that will be isolated and characterized. Highly virulent strains will subsequently be selected and evaluated as a method of biological control. A screening of several thousand chemicals which have already been synthesized is being conducted in order to find specific algicides for the chemical control of the more troublesome blue-green algae.

SEMINARS, WORKSHOPS AND SYMPOSIA

A "Eutrophication-Biostimulation Assessment Workshop," jointly sponsored by FWQA and the Sanitary Engineering Research Laboratory, University of California, Berkeley was held June 19-21, 1969. Topics of discussion included algal assay procedures, algal physiology, limnological investigations, and eutrophication control and applications. The proceedings of this workshop have been published.

A workshop dealing with modeling of the eutrophication process, sponsored jointly by FWQA and the University of Florida, Gainesville, was held at St. Petersburg November 19-21, 1969. Topics of discussion

included concepts of model building, potential for modeling the eutrophication process, the process of eutrophication and criteria used to establish the trophic state, multivariate techniques for classification of lakes and lake basins, models of aquatic ecosystems, biochemical modeling of eutrophic lakes, models of algae population dynamics based on the chemostat approach, and management models.

On March 2-3, 1970, a "Lake Restoration Workshop" was held at FWQA Headquarters, Arlington, Virginia. The major objectives were to assess knowledge of lake deterioration, identify and explore new ideas and concepts of preserving lakes of good quality and restoring lakes already degraded. The workshop was followed by a luncheon and public meeting at the Statler Hilton Hotel in Washington.

PUBLICATIONS

National Eutrophication Research Program

1. Brice, R.M., and C.F. Powers. 1969. The Shagawa Lake, Minnesota, Eutrophication Research Project. In Proceedings of the Eutrophication-Biostimulation Workshop, Berkeley, California.

2. Gahler, A.R. 1969. Sediment-Water Nutrient Interchange. IN Proceedings of the Eutrophication-Biostimulation Workshop, Berkeley, California.

3. Gahler, A.R. 1969. Field Studies on Sediment-Water Algal Nutrient Interchange Processes and Water Quality of Upper Klamath and Agency Lakes. Working Paper No. 66, U.S.D.I., F.W.P.C.A., Pacific Northwest Water Laboratory, Corvallis, Oregon.

4. Miller, W.E., and J.C. Tash. 1967. Interim Report, Upper Klamath Lake, Oregon, Studies. Pub. No. WP-20-8, U.S.D.I., F.W.P.C.A., Pacific Northwest Water Laboratory, Corvallis, Oregon.

5. Maloney, T.E., and A.F. Bartsch. 1969. Research to Save America's Lakes. Chemical Engineering Progress: Symposium Series, Vol. 65, No. 97.

Major Grant and Contract Reports

1. Brezonik, Patrick L. University of Florida. FWQA Research Grant No. 16010 DCK, "The Chemistry of Nitrogen in Natural Waters." Second Annual Progress Report, February 1-November 1, 1969.

2. Jackson, Daniel F. and Vladimir Sladecek. Syracuse University. FWQA Research Contract No. 14-12-457, "The Use of Algal Viruses to Control Eutrophication." Final Report, March 1970.

3. University of Wisconsin, Water Resources Center. FWQA Research Grant No. 16010 EHR. "Eutrophication of Natural Waters."

a) Armstrong, D. E. Role of Phosphorus-Sediment Interactions in Eutrophication.

b) Fitzgerald, G. P. Nutrient Sources for Algae and Their Control.

c) Hasler, A. D. Seasonal Changes in Species--Diversity and Biomass of Phytoplankton, Zooplankton, Benthos and Fishes in Lake Wingra, and the Productivity Index of this Lake.

d) Huff, D. D. A Systems Analysis of Water and Nutrient Flows in the Lake Wingra Basin.

e) Keeney, D. R. Nitrogen Transformations in Lake Sediments.

f) Lee, G. F. Chemical Investigations of Sediment Cores From Wisconsin Lakes and Their Interpretation.

g) McCoy, E. Role of Bacteriology in the Nitrogen Cycle.

h) Rohlich, G. A. Evaluation of Provisional Algal Assay Procedure.

4. Lake Tahoe Area Council. FWQA Demonstration Grant No. WPD-48. "Eutrophication of Surface Waters--Lake Tahoe." Second Progress Report, May 1969.

5. Moore, G. H., Jr., and E. G. Fruh. The University of Texas, Austin. FWQA Research Grant No. WP-01449-01. "Surplus Phosphorus Uptake by Microorganisms--Algae." Technical Report No. 1, January 1969.

6. Megard, Robert O. University of Minnesota Limnological Research Center, Minneapolis. FWQA Research Grant No. 16010 DEG. "Effect of Sewage Effluents on Algae in Shagawa Lake, Minnesota." Interim Report No. 5. Algae and Photosynthesis in Shagawa Lake, Minnesota, April 1969.

7. Brezonik, P. L., Morgan, W. H., Shannen, E. E., and H. D. Putnam. University of Florida, Gainesville. FWQA Demonstration Grant No. 16010 DON. "Eutrophication Factors in North Central Florida Lakes." August 1969.

8. Welch, E. B., Buchanan, R. J., Nece, R. E., and R. H. Bogan. FWQA Research Grant No. WP 01391-01. "Plankton Community and Hydraulic Characterization Preliminary to Lake Flushing." October 1969.

Other Significant Publications

1. Eutrophication: Causes, Consequences, Corrections. Proceedings of a Symposium. National Academy of Sciences, Washington, D. C. 1969. vii + 661 p.

2. Algae, Man and the Environment. Proceedings of a symposium. D. F. Jackson, Ed. Syracuse University Press. 1968. vii + 554 p.

3. Proceedings of the Eutrophication-Biostimulation Assessment Workshop, Berkeley, California. 1969. Sponsored by University of California and Federal Water Pollutuion Control Administration. E. J. Middlebrooks, T. E. Maloney, C. F. Powers, and T. M. Kaack, Eds. iv + 281 p.

GRANT AND CONTRACT RESEARCH

Following is a list of currently active grant and contract projects awarded by the Federal Water Quality Administration dealing with research and development in eutrophication control.

Grantee or Contractor	
Rensselaer Polytechnic Inst. Troy, New York	A study of organic nutrient factors effecting algal growth. Project Director--Nicholas L. Clesceri Project Officer--Thomas E. Maloney
Lake Tahoe Area Council South Lake Tahoe, California	A study of the potential significance of effluents from waste treatment and from land and shoreline management to eutrophication of Lake Tahoe. Project Director--P. H. McGauhey Project Officer--Thomas E. Maloney
Lake Tahoe Area Council South Lake Tahoe, California	A study of the biological, chemical and physical parameters of Indian Creek Reservoir, an impoundment receiving only tertiary treated sewage effluent. Project Director--P. H. McGauhey Project Officer--Thomas E. Maloney
Florida Atlantic University Boca Raton, Florida	A study of organisms for possible use in the biological control of aquatic vegetation. Project Director--Thomas T. Sturrock Project Officer--Thomas E. Maloney
University of North Carolina Chapel Hill, North Carolina	A study to evaluate the Provisional Algal Assay Procedure. Project Director--Charles M. Weiss Project Officer--Thomas E. Maloney
University of Wisconsin Madison, Wisconsin	A study to evaluate the Provisional Algal Assay Procedure. Project Director--C. A. Rohlich Project Officer--Thomas E. Maloney

University of California Berkeley, California	A study to evaluate the Provisional Algal Assay Procedure. Project Director--Erman A. Pearson Project Officer--Thomas E. Maloney
University of Texas Austin, Texas	A study of the soil algae of Texas. Project Director--Harold C. Bold Project Officer--Thomas E. Maloney
University of Connecticut Storrs, Connecticut	A study of the utilization of organic compounds by algae. Project Director--Francis R. Trainer Project Officer--Thomas E. Maloney
University of California Irvine, California	A study of the effect of phosphorus removal processes on algal growth. Project Directors--Jan Scherfig and Peter Dixon Project Officer--Thomas E. Maloney
Cornell University Ithaca, New York	A study of the eutrophication of tidal waters. Project Director--John P. Barlow Project Officer--Thomas E. Maloney
University of California San Diego, California	A study of the role of nitrogen as a controlling factor in the eutrophication of coastal waters. Project Director--Richard W. Eppley Project Officer--Thomas E. Maloney
Dow Chemical Company Midland, Michigan	A study to develop a selective algicide for the control of nuisance algal growth. Project Director--W. F. McIlhenny Project Officer--Thomas E. Maloney
Colorado State University Fort Collins, Colorado	Refractory organic matter as an index of eutrophication. Project Director--Edward B. Reed Project Officer--Leslie P. Seyb

University of Wisconsin Madison, Wisconsin	Nutrient sources for algae and their growth. Project Director--C. P. Fitzgerald Project Officer--A. F. Bartsch
University of Wisconsin Madison, Wisconsin	A biological investigation of Lake Wingra. Project Director--A. D. Hasler Project Officer--A. F. Bartsch
University of Wisconsin Madison, Wisconsin	Nitrogen transformations in lake sediments. Project Director--D. R. Keeney, G. Chesters, and J. G. Conrad Project Officer--A. F. Bartsch
University of Wisconsin Madison Wisconsin	The use of lake sediment cores to study eutrophication of lakes. Project Directors--G. Fred Lee, and C. Bortleson Project Officer--A. F. Bartsch
University of Wisconsin Madison Wisconsin	Role of bacteria in the nitrogen cycle (nitrification). Project Director--Elizabeth McCoy Project Officer--A. F. Bartsch
University of Wisconsin Madison, Wisconsin	Computer simulation of nutrient flows in Lake Wingra basin. Project Director--Donald G. Watts Project Officer--A. F. Bartsch
Michigan State University East Lansing, Michigan	Reversal of eutrophication through artificial aeration of lakes. Project Director--R. C. Ball Project Officer--K. W. Malueg
University of Michigan Ann Arbor, Michigan	An <u>in situ</u> evaluation of nutrient effects on lakes. Project Director--M.E. Bender Project Officer--K.W. Malueg

University of California Berkeley, California	Research and development on the removal of algae from natural bodies of water. Project Director--William J. Oswald Project Officer--Thomas E. Maloney
World Life Research Inst. Colton, California	Pharmacological testing of blue-green algae for constituents having therapeutic value. Project Director--Bruce W. Halstead Project Officer--Leslie P. Seyb
University of Wisconsin Madison, Wisconsin	Role of phosphorus-sediment interactions in eutrophication. Project Director--D. E. Armstrong Project Officer A. F. Bartsch
Battelle-Northwest Richland, Washington	An investigation of the release of phosphorus from lake sediments. Project Director--R. E. Wildung Project Officer--A. R. Gahler
Lake Herman Development Assoc. Madison, South Dakota	Silt removal from a lake bottom. Project Director--Charles S. Johnson Project Officer--A. R. Gahler
Dakota State College Madison, South Dakota	A study to evaluate the effect of silt and silt removal in a northern prairie lake. Project Director--Constance L. Churchill and Gordon Leidahl Project Officer--A. R. Gahler
Harvard University Cambridge, Massachusetts	Phosphate exchange with sediments. Project Director--Werner Stumm Project Officer--A. R. Gahler
Oregon State University Corvallis, Oregon	Sediment water-bacteria interaction in eutrophication. Project Director--R. Y. Morita Project Officer--A. R. Gahler

Rensselaer Polytechnic Inst. Troy, New York	Metal ion complexing in lake waters. Project Director--R. A. Bailey Project Officer--A. R. Gahler
City of Detroit Lakes Minnesota	A study of nutrient control in a eutrophic lake through intensive removal of rooted macrophytes. Project Director--Winston C. Larson Project Officer--John R. Tilstra
University of Minnesota Minneapolis, Minnesota	Community analysis in the littoral zone of lakes. Project Director--H. E. Wright, Jr. Project Officer--K. W. Malueg
University of North Dakota Grand Forks, North Dakota	Nutrient dynamics in an artificially enriched lake. Project Director--J. K. Neel Project Officer--K. W. Malueg
University of Alaska College, Alaska	Dynamics of the nitrogen cycle in lakes. Project Director--V. A. Billaud Project Officer--C. F. Powers
University of Florida Gainesville, Florida	Chemistry of nitrogen in natural waters. Project Director--P. L. Brezonik Project Officer--C. F. Powers
University of Florida Gainesville, Florida	Eutrophication factors in north central Florida lakes. Project Director--H. D. Putnam Project Officer--C. F. Powers
University of Minnesota Minneapolis, Minnesota	Effect of sewage effluents on algae in Shagawa Lake, Minnesota. Project Director--Robert O. Magard Project Officer--C. F. Powers
University of Toronto Toronto, Ontario	The role of sludge worms in promoting eutrophication. Project Director--R. O. Brinkhurst Project Officer--C. F. Powers

WARF Institute Madison, Wisconsin	The carbon dioxide system and eutrophication. Project Director--S. D. Morton Project Officer--C. F. Powers
Washington State University Pullman, Washington	Flushing of small shallow lakes. Project Director--J. F. Orsborn Project Officer--C. F. Powers
University of California Davis, California	Limnology of Lake Tahoe emphasizing water quality. Project Director--C. R. Goldman Project Officer--C. F. Powers

SERVICES AVAILABLE

The technical staff of the National Eutrophication Research Program is available to provide consulting and/or advisory services on the design of laboratory and field investigations, interpretation of data and review of proposals relating to assessing the extent of eutrophication and to the prevention, control and reversal of eutrophication. The services are available to FWQA Headquarters, other Federal Agencies, State Agencies, County Agencies, Municipal Agencies and private institutions. Requests from sources outside of FWQA should be routed through the respective FWQA Regional Director.

WHO'S WHO IN THE NATIONAL EUTROPHICATION RESEARCH PROGRAM

Dr. Alfred F. Bartsch	Chief, National Eutrophication Research Program
Mr. Thomas E. Maloney	Deputy Chief and Chief, Physiological Control Branch
Dr. Charles F. Powers	Chief, Ecological Control Branch
Mr. Arnold R. Gahler	Chief, Sediment-Water Interchange Section
Dr. Kenneth W. Malueg	Chief, Nutrient Control Section
Mr. Robert M. Brice	Chief, Shagawa Lake Eutrophication Control Project
Mr. Karl R. Rukavina	Biological Laboratory Technician
Mr. Marcus D. Schuldt	Supervisory Physical Scientist
Mr. William E. Miller	Chief, Assays Procedure Section

Mr. John Tilstra	Research Chemist
Mr. Donald Schults	Research Chemist
Mr. William Sanville	Research Aquatic Biologist
Mr. Tamotsu Shiroyama	Microbiologist

PLANS FOR FY-71

Studies to evaluate the potential impact of nitrilotriacetic Acid (NTA) will continue through December 1970. They will include short term in situ ^{14}C assays in several lakes of varying trophic levels as well as laboratory algal assays on these lake waters. In addition, long-term assays will be conducted in large basins in some of the lakes.

Evaluation of the Provisional Algal Assay Procedure will continue. Indications are that a standard laboratory "bottle test" procedure will be adopted during the fiscal year. The NTA investigations employing the PAAP will offer an opportunity to evaluate the test procedures in several specific field situations of varying type and allow a direct comparison between the laboratory assay and the in situ assay.

After completion of the NTA studies, additional emphasis will be placed on elucidating the nutritional and environmental requirements of blue-green algae. Also, more emphasis will be placed on the isolation of specific viruses for the control of blue-green algae. It is anticipated that there will be increased efforts in studying other methods for the biological control of eutrophication.

The cooperative studies with the U. S. Forest Service to evaluate the impact of public development on Waldo Lake, Oregon will continue.

It is anticipated that construction of a full scale phosphorus removal plant at Ely, Minnesota will be undertaken. In situ and laboratory assays as well as chemical and physical analyses will continue on Shagawa Lake, its tributaries and waste water influents.

Full scale demonstrations of lake restoration by nutrient inactivation and aeration will be undertaken.

The weed harvesting studies at Detroit Lakes, Minnesota will continue. Emphasis will be placed on evaluating the weed harvesting as a method of nutrient removal.